

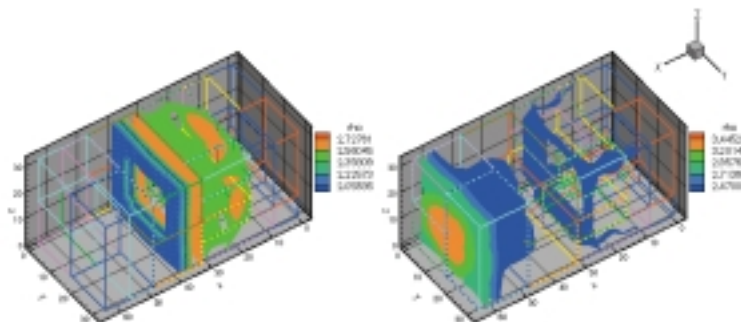
## ASCI Integrated Computing Systems Program

### History and Background

The Advanced Simulation and Computing program (which continues to retain its historical name ASCI) creates simulation capabilities through the development of advanced weapons codes and high-performance computing that incorporate high-fidelity scientific models validated against experimental results, past tests, and theory. The goal is to meet the science-based simulation requirements of the Stockpile Stewardship Program (SSP) so that the National Nuclear Security Administration (NNSA) can complete its nuclear weapons responsibilities. This includes the means to assess and certify the safety, performance, and reliability of nuclear weapons.

The ASCI program actively addresses stockpile issues by developing and using simulations to study problems ranging from advanced design and manufacturing processes, to understanding accident scenarios, to weapons aging and to the resolution of Significant Finding Investigations (SFI). This spectrum of scientific inquiry demands a balanced system of hardware, software, and computer science solutions.

The Integrated Computing Systems program directs platform strategy, procurement, and ongoing operation of the ASCI computer systems. Partnerships with industry ensure technology and system development.



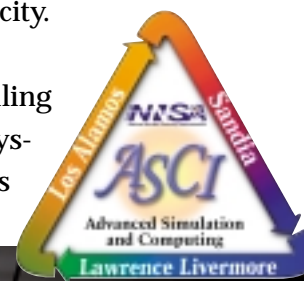
Ravi Samtaney, of the Graduate Aeronautical Laboratories Applied & Computational Mathematics Department at Caltech presented this work at a 2001 ASCI Site Review. The research was performed on 64 processors of the Los Alamos National Laboratory Nirvana machine, running two adaptive mesh refinement (AMR) levels. The simulation suggests likely detonation diffraction around a cube. It was modeled using RM3d (an Eulerian fluid solver) integrated into GrACE (GRid Adaptive Computational Engine) to achieve AMR in the Eulerian solver.

### Physical Infrastructure and Platforms

The three NNSA national laboratories have always been primary customers for new state-of-the-art, high-performance computers and computing simulation capability. Today, the most powerful computing platforms are needed to achieve the performance, simulation, and virtual prototyping applications that the SSP requires.

The ASCI program continues to partner with multiple U.S. computer manufacturers to accelerate the development of larger, faster computer systems and the software required to run these Defense Programs demanding applications. These systems are located at the three NNSA national laboratories — Los Alamos, Lawrence Livermore, and Sandia. All three laboratories share the computing capacity of the largest of these systems, while older systems provide additional computational capacity.

In 2002, ASCI began installing the 30-teraOPS Compaq system ASCI Q at Los Alamos



National Laboratory, and is placing contracts for the next systems. In a partnership with Cray, the Red Storm system will be installed at Sandia National Laboratories in 2004. The contract for ASCI Purple in 2005 at Lawrence Livermore National Laboratory is also being placed. If ASCI receives the NNSA Five-Year National Security Plan (FYNSP) budget, this will become ASCI's first 100-teraOPS machine.

The ASCI platform strategy calls for the acquisition of "commodity" systems. This has typically resulted in architectures consisting of commodity processors tied together by a communication fabric via a network interface switch. In examining the prospects for future high-end systems, we recognize that accelerating research into advanced computing architectures is important and could provide substantial leverage for future ASCI platforms.

As a result, we introduced Advanced Architectures, a new program sub-element in 2001, to promote research and development efforts exploring alternative high-performance computing architectures with implications beyond 2005. The first, and currently only, programmatic activity in this area is close collaboration with IBM on their Blue Gene/L architecture. The first Blue Gene/L system is slated for installation at Lawrence Livermore National Laboratory.

## **Platform Strategies**

- Accelerate the acquisition of scalable commercial high-end systems.
- Develop partnerships with multiple computer companies to ensure appropriate technology and system development.

- Stimulate R&D efforts, through Advanced Architectures, that explore alternative computer designs that promise dramatic improvements in performance, scalability, reliability, packaging or cost.

## **Ongoing Computing**

The Ongoing Computing program element ensures the supply of computing resources needed to support SSP activities at the NNSA national laboratories. This element is structured somewhat differently at each of the laboratories, but program-wide it focuses on the operation of each laboratory's computer centers. In general, that effort has two mission elements (1) to provide ongoing stable production computing services to laboratory programs, and (2) to provide user support for tri-lab customers using the ASCI computational resources.

## **Ongoing Computing Strategies**

- Operate and maintain laboratory computing centers and facilities housing the ASCI computers.
- Deploy the ASCI platforms as they are acquired and support the necessary networks and archives.
- Provide user services and help desks.

Information compiled from the *Advanced Simulation and Computing (ASCI) Program Plan 2002-2003* (SAND-2002-2940P), issued by Sandia National Laboratories, a Department of Energy Laboratory operated by Sandia Corporation, a Lockheed Martin Company, under contract DE-AC04-94AL85000. The Program Plan was issued under the joint auspices of Sandia National Laboratories, Los Alamos National Laboratory, and Lawrence Livermore National Laboratory.